

AMENDMENT TO THE CLAIMS:

This listing of claims will replace all prior versions of claims in the application:

LISTING OF CLAIMS:

1. (ORIGINAL) A magnetic head, comprising:  
a sensor having a free layer, the free layer having a magnetic moment; and  
hard bias structures positioned towards opposite ends of the sensor, the hard bias  
structures stabilizing the magnetic moment of the free layer, each hard  
bias structure comprising:  
an antiparallel (AP) pinned layer structure, the AP pinned layer structure  
having a middle pinned layer aligned along a plane of the free  
layer of the sensor, and outer pinned layers positioned on  
opposite sides of the middle pinned layer; and  
an antiferromagnetic layer positioned towards each of the AP pinned  
layer structures, each antiferromagnetic layer stabilizing a  
magnetic moment of the pinned layer closest thereto.
2. (ORIGINAL) A head as recited in claim 1, wherein a net magnetic moment of  
the AP pinned layer structure is about zero.
3. (ORIGINAL) A head as recited in claim 1, wherein a thickness of the middle  
pinned layer is at least as thick as the free layer of the sensor.
4. (ORIGINAL) A head as recited in claim 1, wherein a thickness of the middle  
pinned layer is at least twice as thick as the free layer of the sensor.

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5. (ORIGINAL) A head as recited in claim 1, wherein the outer pinned layers are misaligned from the free layer.
6. (ORIGINAL) A head as recited in claim 1, wherein the pinned layers of the AP pinned layer structure each include at least Co, wherein the pinned layers are separated by a layer of Ru.
7. (ORIGINAL) A head as recited in claim 1, wherein the antiferromagnetic layers each include at least one of PtMn and IrMn.
8. (ORIGINAL) A magnetic head, comprising:  
a sensor having a free layer, the free layer having a magnetic moment; and  
hard bias structures positioned towards opposite ends of the sensor, the hard bias structures stabilizing the magnetic moment of the free layer, each hard bias structure comprising;  
an antiparallel (AP) pinned layer structure, the AP pinned layer structure having a first pinned layer aligned along a plane of the free layer of the sensor, and at least a second pinned layer for pinning a magnetic orientation of the first pinned layer; and  
an antiferromagnetic layer positioned towards each of the AP pinned layer structures, each antiferromagnetic layer stabilizing a magnetic moment of the pinned layer closest thereto.
9. (ORIGINAL) A head as recited in claim 1, wherein a net magnetic moment of the AP pinned layer structure is about zero.
10. (ORIGINAL) A head as recited in claim 1, wherein a thickness of the first pinned layer is at least as thick as the free layer of the sensor.

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11. (ORIGINAL) A head as recited in claim 1, wherein a thickness of the first pinned layer is at least twice as thick as the free layer of the sensor.
12. (ORIGINAL) A head as recited in claim 1, wherein the at least second pinned layer is misaligned from the free layer.
13. (CANCEL) A magnetic head, comprising:  
a sensor having a free layer, the free layer having a magnetic moment; and  
hard bias structures positioned towards opposite ends of the sensor, the hard bias structures stabilizing the magnetic moment of the free layer, each hard bias structure comprising;  
an antiparallel (AP) pinned layer structure, the AP pinned layer structure having a first pinned layer aligned along a plane of the free layer of the sensor, and at least a second pinned layer for pinning a magnetic orientation of the first pinned layer.
14. (CURRENTLY AMENDED) A magnetic head as recited in claim 13,  
comprising:  
a sensor having a free layer, the free layer having a magnetic moment; and  
hard bias structures positioned towards opposite ends of the sensor, the hard bias  
structures stabilizing the magnetic moment of the free layer, each hard  
bias structure comprising;  
an antiparallel (AP) pinned layer structure, the AP pinned layer structure  
having a first pinned layer aligned along a plane of the free layer  
of the sensor, and at least a second pinned layer for pinning a  
magnetic orientation of the first pinned layer;  
wherein each AP pinned layer structure includes a middle pinned layer aligned along a plane of the free layer of the sensor, and outer pinned layers positioned on opposite sides of the middle pinned layer.

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15. (CURRENTLY AMENDED) A head as recited in claim ~~13~~ 16, wherein a net magnetic moment of the AP pinned layer structure is about zero.
16. (CURRENTLY AMENDED) A magnetic head as recited in claim 13,  
comprising:  
a sensor having a free layer, the free layer having a magnetic moment; and  
hard bias structures positioned towards opposite ends of the sensor, the hard bias  
structures stabilizing the magnetic moment of the free layer, each hard  
bias structure comprising:  
an antiparallel (AP) pinned layer structure, the AP pinned layer structure  
having a first pinned layer aligned along a plane of the free layer  
of the sensor, and at least a second pinned layer for pinning a  
magnetic orientation of the first pinned layer,  
wherein a thickness of the first pinned layer is at least as thick as the free layer of  
the sensor.
17. (CURRENTLY AMENDED) A magnetic head as recited in claim 13,  
comprising:  
a sensor having a free layer, the free layer having a magnetic moment; and  
hard bias structures positioned towards opposite ends of the sensor, the hard bias  
structures stabilizing the magnetic moment of the free layer, each hard  
bias structure comprising:  
an antiparallel (AP) pinned layer structure, the AP pinned layer structure  
having a first pinned layer aligned along a plane of the free layer  
of the sensor, and at least a second pinned layer for pinning a  
magnetic orientation of the first pinned layer;  
wherein a thickness of the first pinned layer is at least twice as thick as the free  
layer of the sensor.

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18. (CURRENTLY AMENDED) A head as recited in claim ~~13~~ 16, wherein the at least second pinned layer is misaligned from the free layer.
19. (ORIGINAL) A magnetic storage system, comprising:
  - magnetic media;
  - at least one head for reading from and writing to the magnetic media, each head having:
    - a reading portion having the structure recited in claim 1;
    - a write element coupled to the sensor;
  - a slider for supporting the head; and
  - a control unit coupled to the head for controlling operation of the head.
20. (CURRENTLY AMENDED) A magnetic storage system, comprising:
  - magnetic media;
  - at least one head for reading from and writing to the magnetic media, each head having:
    - a reading portion having the structure recited in claim ~~13~~ 16;
    - a write element coupled to the sensor;
  - a slider for supporting the head; and
  - a control unit coupled to the head for controlling operation of the head.

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